Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-01	OI
BSTR-03, DPS-01	**GMT:**		**SPR** 51RF09	**UA**	**Manager:**
			IPR 60V-0004	**PR** MPS-3-18-1146	x39037
					Engineer:

Title: Engine 2 LH2 Inlet Pressure Failure/FA2 MDM Analog Input BITE (ORB)

Summary: DISCUSSION: During STS-51 ascent, at approximately 255:11:50 G.m.t. (approximately five minutes after liftoff), Space Shuttle main engine (SSME) 2 liquid hydrogen (LH2) inlet pressure indicator (V41P1200C) failed off-scale high. Coincident with this indication, an analog input built-in test equipment (BITE) was logged in the flight critical aft 2 (FA2) multiplexer/demultiplexer (MDM). The BITE bit that was set indicates a problem with input card 14, channel 16, which is the input path for this main engine measurement. At the time of the failure, it was unclear whether the transducer failed, resulting in a voltage high enough to cause the BITE, or the MDM hardware failed, causing the BITE. The dedicated signal conditioner (DSC) through which the engine measurement is routed was also suspect. However, no other measurements on MDM FA2 or the DSC appeared anomalous.

This measurement is used during prelaunch operations to determine the quality of the H2 being supplied to the main engines. Four of these transducers are used, one for each engine and one on the common supply line to the engines. Any one of the transducers can be used in conjunction with temperature measurements on the same line to determine the H2 quality. This is a criticality 3 measurement, and a prelaunch failure or failure during flight has no impact on continued operations. The data from the transducer are used postflight for data analysis. Postflight inspections revealed that the transducer caused the failure. This transducer, serial number (s/n) 140, was removed and replaced. Checkout results of the replacement unit were good. The failed transducer was returned to the vendor for failure analysis. Analysis revealed that three of the gold wire leads were broken in the transducer due to thermal and vibration-related fatigue. A lack of proper stress relief on the leads was noted. The vendor has acknowledged that a number of transducers may have been manufactured with inadequate stress relief, and the vendor has been requested to identify those transducers by serial number. Further troubleshooting, analysis, and corrective action will be tracked under CAR 51RF09-010. The failure history on this type of transducer suggests that cryogenic- temperature stress contributes to the failure. The transducers that are not subject to the extreme temperatures have only sustained one failure (in 1984) due to lack of stress relief being incorporated in the sensor circuitry during manufacturing. There are over 600 of the sensors in this category in the fleet. The transducers that are subject to the extreme thermal stress number much fewer and fail more frequently: only 32 in the fleet and four previous failures similar to the one experienced during

STS-51. These numbers strongly suggest a correlation between thermal stress and failure of the transducers that do not have sufficient stress relief. A new type of transducer will be manufactured to replace the current transducers on an attrition basis, and the certification will ensure that the stress relief loop is incorporated into the new transducer. Until then, the transducers currently in the fleet should cause no concern if they fail as the transducers that are subject to the cryogenic temperatures are criticality 3 and will not cause a launch scrub, an early mission termination, or an increase in safety risk. The criticality 1/R and criticality 2 transducers which may have inadequate stress relief are subject to a more benign thermal environment and have not exhibited an increased failure rate due to the lack of stress relief. CONCLUSION: This anomaly was caused by a failed transducer. The failure mechanism is broken wires in the transducer due to fatigue. CORRECTIVE_ACTION: The transducer has been removed and replaced. The failed transducer will not be returned to the fleet. A fix for newly manufactured transducers is planned. It will require the vendor to manufacture the transducers with adequate stress relief incorporated. This will prevent recurrence of the problem. A review of the affected transducers that are still in the field is also planned. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-51-V-02	PSA
EVA-01	GMT:		SPR 51RF02	UA	Manager:
			IPR	PR CM-3-18-0296	
					Engineer:

Title: Port PSA Sliding Door Failure to Close (ORB)

Summary: DISCUSSION: During the second extravehicular activity (EVA), the port provision stowage assembly (PSA) door became jammed in the open position and had to be pried out from this position to get it closed.

During postflight troubleshooting, the port PSA was inspected with the following discrepancy noted: The front edge of the door handle door stop was almost in line with the edge of the flipper door hinge; The chamfered sections on the side pieces of the door handle had marks on them which suggested that they had been driven up under the door close-out panel. During a closer inspection of the hardware and a review of the original equipment manufacture (OEM) drawings, an apparent repair to the close-out panel had been made and approved via a material review (MR). The repair was to replace the close-out panel integral door-stop flange that was inadvertently removed from the panel. The replacement was a strip of Aluminum 0.063 in. thick and 0.78 in. wide riveted in place to the close-out panel to prevent the door from sliding up underneath the close-out panel. The replacement did not incorporate a 0.30 in. flange on the leading edge to act as the top for the sliding-door handle mechanism; consequently, the MR'd panel did not limit the door travel to the same extent as the original design and did not provide the same required stiffness as the original section that was missing. The resulting flexibility allowed the door handle stop to deform the closeout panel and ride under the panel edge jamming the door. The close-out panel was removed from OV-103 and replaced with OV-104's close- out panel. The MR'd close-out panel has been removed from flight spares and will be replaced with a newly-manufactured panel. CONCLUSION: A change was made to the PSA close-out panel that allowed the PSA door to travel past the door stop/contact points and become jammed in the open position. CORRECTIVE_ACTION: The close-out panel was removed and replaced with OV-104's close-out panel. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-51-V-03	Water and Waste
EECOM	GMT:		SPR 51RF03	UA	Manager:
			IPR	PR ECL-3-18-096	x30770
					Engineer:

Title: Humidity Separator B Water Carryover (ORB)

Summary: DISCUSSION: At approximately 258:06:00 G.m.t., during flight day 4 postsleep activities, about four tablespoons of water carryover were found by the crew on humidity separator B exit screen. Humidity separator B was the active system. The crew stated they used towels to absorb the water. The humidity separator was checked again at approximately 258:18:50 G.m.t. during pre-sleep activities on flight day 4 and once again about four tablespoons of water carryover were found. The crew absorbed the water by using towels. The crew checked the humidity separator during post-sleep activities on flight day 5, and the amount of water carryover was approximately 3/4 of a cup. The water was again absorbed by using towels. The decision was made to switch to humidity separator A. Humidity separator A operated for the remainder of the flight with no water carryover observed.

Prior to the flight, both humidity separators A and B had been flushed at the OMRSD specified 19 to 27 cc/min flow rate to remove latent debris. During postflight turnaround activities, the humidity separator package s/n 00005 was removed and replaced with s/n 00001. The removed humidity separator package was sent to the NASA Shuttle Logistics Depot (NSLD). Both units A and B were subjected to the acceptance test procedure (ATP) flowrate of 27 cc/min with unit A passing and unit B failing the test. During refurbishment, debris was found to have accumulated in the pitot tube of humidity separator B. The debris was deposited in a way that appeared to have been a gradual buildup over a long period of time. The composition and source of the debris is still under investigation. This particular humidity separator package was on its ninth flight, and was considered to be the fleet leader. During flights, humidity separator B generally experiences much more use than unit A, so unit B had the most exposure to slow debris buildup. CONCLUSION: The water carryover on humidity separator B was caused by a gradual accumulation of debris in the pitot tube. CORRECTIVE_ACTION: The humidity separator was replaced and sent to NSLD for refurbishment. After completion of the refurbishment process, the humidity separator will be placed back into service. An OMRSD requirement has recently been implemented to remove and refurbish humidity separators at each Orbiter maintenance down period (OMDP), so other units will not experience as much use as this unit did. The composition and source of the debris, as well as final corrective action will be documented on CAR 51RF03-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-51-V-05	OMS/RCS
PROP-01	GMT:		SPR 51RF05	UA	Manager:
			IPR	PR LP01-21-0594	

Engineer:

Title: Aft RCS Thruster L3L Fail-Off (ORB)

Summary: DISCUSSION: Reaction control subsystem (RCS) primary thruster L3L was declared failed-off during the RCS hot-fire test. This was the first attempted firing of thruster L3L during the mission. When the fire command was initiated, the thruster chamber pressure increased to only 2.5 psia prior to deselection by redundancy management (RM) at 320 msec. RM declares a thruster failed-off after receiving three consecutive chamber pressure discretes indicating a chamber pressure of less than 36 psia. The nominal chamber pressure for a primary thruster is appproximately 152 psia.

Injector tube temperature data indicate both fuel and oxidizer flow. The oxidizer flow was most probably pilot-valve-only (or limited) flow, which accounted for the low chamber pressure. The oxidizer valve main stage probably failed to open fully due to iron nitrate contamination of the pilot stage. The RCS oxidizer valve has a pressure-operated main stage and a failure to operate due to iron nitrate contamination is the most common failure mode. The thruster was left deselected for the remainder of the mission. A review of data from the previous flight of this thruster (STS-56) indicates that it also experienced an unusual pulse during the RCS hot-fire on that mission. When the fire command was initiated, the thruster chamber pressure stepped-up to 32 psia over a period of 240 msec prior to reaching a nominal chamber pressure for the remainder of the pulse. This off-nominal performance was probably due to contamination in the oxidizer valve. Thruster L3L (S/N 337) has flown 18 missions, all with the same oxidizer valve. The oxidizer valve is a -505 configuration and the thruster will be removed and sent to the White Sands Test Facility (WSTF) for valve flushing. If flushing is successful in clearing the contamination, the thruster will be returned to service. If the flushing fails, the thruster will be returned to the vendor for refurbishment. CONCLUSION: The most probable cause of the thruster fail-off was iron nitrate contamination in the oxidizer-valve pilot-stage that prevented its proper operation. CORRECTIVE_ACTION: KSC has replaced thruster L3L and it will be transferred to the WSTF for the thruster-flush program. The primary thruster oxidizer and fuel valves have pressure-operated main stages and are susceptible to failure due to iron nitrate contamination. Iron nitrate formation is assisted by the presence of water (moisture) in the oxidizer valve. Therefore, the primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system. Also, a program to develop a direct-acting valve, which would be less susceptible to failure from iron nitrate contamination, is currently being considered. Results of the thruster flush at the WSTF and any necessary failure analysis will be documented in CAR 51RF05. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-06	D&C - Lighting
EGIL-01	**GMT:**		**SPR** 51RF06	**UA**	**Manager:**
			IPR 60V-0010	**PR** DDC-3-18-0085	x31512
					Engineer:

Title: Mid Starboard Payload Bay Floodlight Failure (ORB)

Summary: DISCUSSION: On flight day 8, the crew reported that the mid starboard payload bay floodlight was flickering and did not come up to full bright. The light was powered off. On the mid MN C amps, small spikes were seen which would relate to arcing and flickering. The postflight KSC visual inspection verified arcing in this light.

The arcing problems which are causing the floodlights to fail on-orbit are related to the loss of the nitrogen backfill in the floodlights. The lights are sealed at 0.5 atm with pure nitrogen at the NASA Shuttle Logistics Depot (NSLD), but with time this backfill decays to the point where Corona effects begin to occur due to the high voltage required to ignite the floodlights. Rockwell has tested a proposed fix for the arcing problem which involves reversing the anode and cathode of the bulb, using a redesigned seal, and backfilling the unit to 1.0 atm with a 90/10 nitrogen/helium gas mixture. This change will be brought forward to the OER and CCB by late October or early November for approval. CONCLUSION: Loss of the backfill on the mid starboard payload bay floodlight caused the arcing condition on the light. CORRECTIVE_ACTION: The floodlight will be removed and sent to NSLD for troubleshooting. The troubleshooting results and any further corrective actions will be tracked under the noted CAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: Random floodlight failures may continue to occur until all hardware has been modified to a new configuration.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-07	DPS - MDM
DPS-02	**GMT:**		**SPR** 51RF07	**UA**	**Manager:**
			IPR 60V-0009	**PR**	x38351
					Engineer:

Title: MDM PF2 I/O Error (ORB)

Summary: DISCUSSION: During STS-51 deorbit preparation for the second landing attempt, at 265:04:59 G.m.t., the backup flight system (BFS) bypassed the payload forward 2 (PF2) multiplexer/demultiplexer (MDM). An input/output (I/O) error fault summary message was annunciated. An I/O reset, performed by the crew, was unsuccessful. A port mode to secondary ports recovered the MDM. This configuration on secondary ports was maintained for the remainder of the flight without further problems.

Postlanding, a port mode back to primary ports resulted in BFS again bypassing the MDM and annunciating the I/O error, indicating that the original problem with the primary port still existed. A power cycle cleared the problem, as evidenced by the subsequent I/O reset restoring normal operations. Loss of redundancy to close the payload bay doors and to command the communications system, as well as loss of redundancy to command several Orbiter systems would have resulted with the complete loss of this MDM. However, only the primary port was failed, and the port mode restored all of the original redundancy to these areas. This particular MDM, serial number (s/n) 27, has sustained two sequence control unit (SCU) halts previously during vehicle processing, one in 1991, and one in 1992. The SCU halt indications are similar to those seen during the STS-51 failure. A power cycle recovered the MDM from two previous failures, as it did with the in-flight failure. The SCU halt is a known condition believed to be caused by an internal timing problem in the MDM's self-check circuitry. The SCU halts are always recovered with a power cycle. All of the MDMs, including the flight critical forward and aft (FF and FA) MDMs, are susceptible to this failure, but most have been modified to make the failures less frequent. MDM s/n 27 had the modification prior to the first of these three SCU halts. There is one other unit in the field with the modification which has experienced multiple SCU halts, spare PF MDM s/n 98. This MDM was built with the modification. This particular failure does not affect the enhanced MDMs (EMDMs). Under current philosophy, an MDM is removed only after three transient failures unless two failures occur within a six-month period. For this reason, the failed MDM was not removed after the second failure. However, due to the in-flight failure, MDM s/n 27 was removed and replaced with s/n 02. MDM s/n 27 was sent to the NASA Shuttle Logistics Depot (NSLD), where it is now waiting for testing and evaluation. If no cause for the problem is found, the MDM will either be sent to Shuttle Avionics Integration Laboratory (SAIL) for 500 hours of run time and returned to the fleet, or the primary SCU module will be replaced. CONCLUSION: The MDM experienced an SCU halt. This conclusion is based on previous similar failures witnessed on this particular unit. CORRECTIVE_ACTION: The MDM was removed and replaced and sent to the NSLD. Failure analysis will be tracked by the CAR 51RF07. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should this failure recur in-flight, a port mode would restore system capability as it did on this particular occurrence. Should the secondary port be failed, a power cycle and port mode to primary ports should recover the MDM.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-08	APU
MMACS	**GMT:**		**SPR** 51RF08	**UA**	**Manager:**
			IPR 60V-0008	**PR**	x39047
					Engineer:

Title: APU 3 Bearing Temp 2 Failed Off Scale High (ORB)

Summary: DISCUSSION: During entry at 265:07:22 G.m.t., (09:19:37 MET), approximately 11 minutes after auxiliary power unit (APU) 3 was started, the APU gearbox bearing temperature 2 (V46T0362A) measurement failed off-scale high. The rapid failure was indicative of an open circuit that was most likely caused by the sensor. No crew action was taken because of this failure. APU gearbox bearing temperature 1 and the lube oil outlet temperature were nominal during entry which gave continuous insight to APU 3 gearbox performance.

Postflight troubleshooting verified the resistance and voltage measurements of the bearing temperature sensor were faulty. Also, troubleshooting verified that all system hardware up to the sensor was normal. Sensor replacement is complete. Verification testing of the new sensor was successful. This bearing temperature sensor (s/n V3M004) was built prior to 1987. Sensors built prior to 1989 are suspected of having inadequate epoxy potting which could lead to wire fracture due to vibration. (ref CAR AD3701). These sensors are being replaced on an attrition basis. The cause of this failed sensor could be inadequate epoxy potting. CONCLUSION: The off-scale high failure mode of the APU 3 gearbox bearing temperature measurement is an open circuit within the temperature sensor. The open circuit in the sensor could have been a result of a wire fracture caused by vibration due to inadequate epoxy potting. CORRECTIVE_ACTION: The ground troubleshooting was able to determine the APU 3 gearbox bearing temperature sensor had failed. The sensor has been replaced and verification testing was successfully completed. This APU gearbox bearing temperature sensor problem is being documented in CAR 51RF08-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR** ADR 76854	**IFA** STS-51-V-09	CCTV
INCO-05	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR 60V-0012	**PR**	x30184
					Engineer:

Title: Lines and Weak Image on Monitor 2 (ORB)

Summary: DISCUSSION: The crew reported that CCTV monitor 2 contained horizontal lines, was scrolling, and had bands across the center of the picture. In-flight testing was inconclusive in resolving the reported problem. Postflight troubleshooting at KSC was unable to repeat the monitor 2 problem.

CONCLUSION: This anomaly is indicative of a faulty power supply. CORRECTIVE_ACTION: CCTV monitor 2 has been sent to the vendor. Further troubleshooting and analysis will be tracked by ADR 76854. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-10	VIDEO
INCO-04	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR 60V-0013	**PR**	x30184
					Engineer:

Title: Orbiter Processed Degraded Color Burst from SPAS EMU R/F Video Signal. (ORB)

Summary: DISCUSSION: During SPAS boresight camera video operations, playback of recorded video and real-time transmitted video through TDRSS during the SPAS deploy had no color. Ground processing of the playback indicated a diminished color burst level in the video signal. A good color signal was observed in the original transmission both onboard and directly to the ground stations at Goldstone and MILA, and via TDRSS during SPAS retrieval and Orbiter survey activities. Degraded color was also observed in the video that was recorded on the TEAC VCR onboard the Orbiter. This video was recorded on the TEAC VCR onboard the Orbiter. Since playback of other color recordings through other paths was not affected, the monitor was not suspect. The SPAS TV transmitter was not suspect because the original transmission was received without problem on the ground.

The hardware was removed from the vehicle and returned to JSC for evaluation. This testing repeated the problem, but did not isolate it to a single component or identify any hardware that had failed. As noted during the flight, the problem involves reduced color burst signal levels. The testing revealed that the problem results from a stackup of attenuations of the signal, primarily involving the video processing portion of the receiver/video processor assembly and the TEAC recorder. Taken separately, these attenuations were within specification. The low levels put out by this combination of hardware were originally readable by the onboard CCTV monitor, but further attenuation within the recorder resulted in a color burst signal that was too low to acquire during playback. This condition was not caught during ground checkout because of the higher sensitivity of the GSE monitor. Color was observable during playback of the flight tapes using more sensitive ground equipment at JSC. CONCLUSION: The degraded color burst signal results from a stackup of attenuation involving the video processing portion of the EMU TV receiver/video processor assembly and the TEAC recorder. CORRECTIVE_ACTION: Corrective action will involve modification of the recorder and receiver assembly video processing circuitry designs and adjustments to the VCR sensitivity circuitry which will improve hardware compatibility EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The hardware is not currently manifested for use on any flight. Should the problem recur, attenuation of the color signal does not affect crew safety or mission success.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-11	MPS
BSTR-04	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR 60V-0014	**PR** DDC-0088	
					Engineer:

Title: MPS Center Engine GHe Reg Press Meter Off-Flag Set (ORB)

Summary: DISCUSSION: While performing the main propulsion system (MPS) reconfiguration during the deorbit preparations (TIG-25 minutes), the crew reported that the center engine helium regulator pressure meter (meter 4 on panel F7) was indicating "off". The other indications on the meter (pneumatic, left engine, and right engine regulator pressures) were nominal. Also, telemetry (V41P1154A) and the hardware caution and warning for the center engine regulator pressure were nominal, indicating that the pressure transducer had not failed. Had it been required, the crew could have monitored the engine helium regulator pressures on the BFS GNC SYS SUMM 1 display (DISP 18). The crew reported during the crew debriefing that it was noticed that the meter was indicating properly after entry interface.

Postflight vehicle troubleshooting consisted of flexing wire harnesses, demating and inspecting the connector at the meter, and inducing a signal to the meter at the transducer. This troubleshooting was unable to duplicate the anomaly. The meter, which had been installed on OV-103 prior to STS-51, was then removed and sent to the NASA Shuttle Logistics Depot (NSLD) for testing and evaluation. Testing included a functional test, an accuracy test, a partial acceptance thermal test, and a half-power vibration test; and the problem was not duplicated. The functional and accuracy tests were then repeated, again without recurrence of the anomaly. Finally, the meter underwent a successful acceptance test procedure and was returned to the vehicle. The problem seen during STS-51 has not been experienced previously. A possible cause of the anomaly is that one pole of the MPS helium tank/regulator pressure switch (S1 on panel F7), which allows the signal to reach the meter, initially failed to make contact. This "switch tease" condition has been experienced in the past on other switches. The performance of the meter will be monitored on future flights, and the results of the failure investigation will be documented under CAR 51RF10. CONCLUSION: The center engine pressure meter failed during deorbit preparations and recovered shortly after the deorbit burn. Troubleshooting could not duplicate the anomaly. A possible cause of the anomaly is that one pole of the MPS helium tank/regulator pressure switch (S1 on panel F7) initially failed to make contact. CORRECTIVE_ACTION: Troubleshooting performed on the vehicle and on the meter at the NSLD was unable to duplicate the anomaly. The meter was acceptance tested and returned to the vehicle. The results of the testing will be documented in CAR 51RF10. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-12	FC/PRSD
None	**GMT:**		**SPR** 51RF11	**UA**	**Manager:**
			IPR 60V-0018	**PR**	
					Engineer:

Title: Fuel Cell 1 H2 Reactant Valve Talkback (ORB)

Summary: DISCUSSION: During the fuel cell shutdown (DTO 412) process at 262:14:18 G.m.t., the crew reported that the fuel cell 1 H2 reactant valve position talkback (event indicator MC432-0222-0043) indicated closed after a delay of 4 seconds. A review of the flight data indicates that both the H2 and O2 valves closed simultaneously after the switch was thrown (V45X1150E and V45X2150E). A review of the essential bus 1BC voltage (V76V0130A) showed the reactant valve switch was held by the crew in the closed position for 5.0 seconds.

The Rockwell Functional and Operating Performance specification for the event indicator requires the response time to be within 0.5 second when the input signal voltage is applied or removed. The fuel cell 1 H2 reactant valve is used to isolate fuel cell 1 from the Hydrogen tank storage system in case of a leak. The event indicator shows the valve to be functioning correctly as selected by the reactant valve switch. The indicator on panel R1 is a talkback only and has no effect on the operation of the valve. If the indicator fails, the valve position can be determined via the cabin cryo/fuel cell CRT display page 068, and telemetry. Also, should there be any doubt that the fuel cell reactant valve switch did not drive the reactant valve closed, a redundant reactant valve switch on panel C3A5 can close the valve. The event indicator is powered by a 28-volt source when the reactant valve is open. The power drives the armature which is connected to the flag arm that covers and uncovers the open/close nomenclature. During the sluggish response period, the event indicator was transitioning from the powered open position to the unpowered valve closed position. This problem is not considered to be an electrical type anomaly because the power was verified to be removed from the indicator when the crewmember released the reactant valve switch. The system design configuration does not afford any built in capacitance that could potentially provide power to the event indicator. In addition, the event indicator performed properly in its powered state both on-orbit and during troubleshooting at KSC. There have been sluggish or temporary sticking of indicators reported in the past. The amount of time for the complete transfer for previous sluggish or sticky indicators has been from 15 seconds to 3 minutes. The causes have been metallic contamination inside the indicator or errors during manufacture. CAR AA2768 was a sticking movement due to a foreign particle. CAR AB0353 was intermittently sticking; metallic particles were found inside. CAR AC1174 had slow response due to a film contaminant on the ceramic stop bead. CAR KB2479 was a slow activation problem due to an out-of-tolerance (too small) gap between the armature and magnet. Postflight troubleshooting could not duplicate the STS-51 problem. Therefore, the most likely cause of the sluggish event indicator, in light of the previous failures, was transient contamination that was cleared during cycling of the event indicator.

CONCLUSION: If a failure occurs on future flights, the valve position can be determined by other methods. The most probable cause of the sluggish event indicator is contamination that has been cleared during cycling of the event indicator. CORRECTIVE_ACTION: The event indicator was tested at KSC. The failure mode could not be duplicated. The event indicator will be observed for its performance on future flights. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51-V-4	OMS/RCS
PROP-02	**GMT:**		**SPR** 51RF04	**UA**	**Manager:**
			IPR	**PR** RP03-19-0614	
					Engineer:

Title: Aft RCS Thruster R1R Pressure Transducer Abnormality (ORB)

Summary: DISCUSSION: At approximately 263:06:49 G.m.t., during the reaction control subsystem (RCS) hot-fire, RCS primary thruster R1R exhibited an abnormal chamber pressure signature. When the fire command was initiated, the thruster chamber pressure initially indicated 162 psia, which is typical at start-up. However, the indicated chamber pressure decayed during the first 120 msec of the pulse prior to leveling off at a pressure of approximately 50 psia during the remainder of the 480-msec pulse. Upon shutdown, the indicated thruster chamber pressure stabilized at approximately 15 psia when it should have dropped to 0 psia.

A review of thruster-injector-tube temperature data indicated that propellant flow to the thruster appeared nominal and an examination of vehicle rate data, although not conclusive for the hot-fire pulse, also indicated nominal thruster performance. In an effort to show conclusively that the chamber pressure performance seen during the hot-fire was an instrumentation problem, the thruster was fired a second time. Once again the indicated chamber pressure was off-nominal, never exceeding 50 psia; however, vehicle rate data indicated that the thruster performance was nominal. The thruster was placed in last priority and deselected and was not used for the remainder of the mission. During entry, the thruster R1R indicated-chamber-pressure increased as the ambient pressure increased, showing 30 psia after landing. Postflight troubleshooting at KSC indicates that the most probable cause of the abnormal pressure signature was the failure of the chamber pressure transducer on thruster R1R. This troubleshooting included pressurizing the thruster chamber to 60 psig as well as creating a vacuum in the chamber. In each case, the transducer reading remained at 30 psia. The pressure trnasducer uses a strain-gage-backed diaphragm referenced to a vacuum and employs a wheatstone bridge. The failure signature experienced during the hot-fire has never been seen previously and an electrical failure of the transducer is suspected. However, a mechanical failure or some combination of failures cannot be ruled out. Failure modes considered include gas breach into the transducer vacuum reference, a cracked chamber pressure (Pc) tube (the port that allows pressurization of the transducer), or blockage of the Pc tube. However, none of these failure modes is readily supported by the data, and an initial inspection of the Pc tube did not indicate an anomaly. The thruster was removed from the vehicle and replaced. The thruster will be transferred to the vendor for failure analysis. CONCLUSION: Thruster R1R probably experienced a failure of its chamber pressure transducer. The failure signature has never been seen previously and the specific failure mode is not known at this time. CORRECTIVE_ACTION: KSC has removed and replaced thruster R1R. The thruster has been returned to the vendor where the transducer will be removed and a failure analysis will be performed. Results of the failure analysis will be documented in CAR 51RF04. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.